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TUESDAY, OCTOBER 25, 1977

PART II

DEPARTMENT OF AGRICULTURE

Farmers Home Administration

■

RURAL HOUSING (RH) LOAN PROGRAMS

Thermal Performance Standards

[3410-07]

Title 7—Agriculture

CHAPTER XVIII—FARMERS HOME ADMINISTRATION, DEPARTMENT OF AGRICULTURE

[FmHA Instruction 424.1]

PART 1804—PLANNING AND PERFORMING DEVELOPMENT WORK

Subpart A—Planning and Performing Development Work

THERMAL PERFORMANCE STANDARDS

AGENCY: Farmers Home Administration, USDA.

ACTION: Final rule.

SUMMARY: The Farmers Home Administration, amends its regulations to establish thermal performance standards to be used as eligibility criteria for all single family and multifamily dwelling units to be constructed or purchased with Rural Housing loan and grant funds. FmHA has determined that existing thermal performance standards as stated in the Minimum Property Standards (MPS) do not provide adequate protection for the FmHA borrower. This document supplements the Minimium Property Standards which are currently used.

EFFECTIVE DATE: All construction which commences after March 15, 1978. This interim period is intended to provide the industry with time to adjust inventories and production methods.

FOR FURTHER INFORMATION CONTACT:

Daniel J. Ball, 202-447-3394.

SUPPLEMENTARY INFORMATION: 1. Introduction. 2. Unilateral Action by FmHA. 3. Format of Standards. 4. Validity of Cost Effectiveness Study. 5. Other Cost-Effective Measures.

1. INTRODUCTION

On March 21, 1977, the Farmers Home Administration published a notice of proposed rulemaking, 42 FR 15317 to amend Section 1804.3 paragraph (d) (1) and to add Appendix D to Subpart A, Part 1804, Chapter XVIII, Title 7, CFR (36 FR 18062), to establish thermal performance standards for new dwellings to be constructed with Rural Housing (RH) loan and grant funds and for existing dwellings to be purchased with RH funds. These standards are intended to replace selected portions of the Minimum Property Standards (MPS) for use by the Farmers Home Administration.

Interested persons were invited to submit comments concerning this proposal by April 20, 1977. Because of the number of comments received and indications of interest by several industry groups, the period for public comment was extended first until May 20, 1977, and then again to July 19, 1977. In response to the notice of proposed rulemaking, 504 written comments were received by FmHA. This final rule contains revisions to the proposed rule which reflect FmHA's consideration of the comments as well as other information available to FmHA.

2. UNILATERAL ACTION BY FMHA

A number of comments questioned the unilateral action by FmHA in promulgating standards which would not be consistent with those used by other Federal agencies, i.e., The Department of Housing and Urban Development (HUD) and the Veterans Administration (VA). A number of these comments pointed out that Pub. L. 94-385 "Energy Conservation Standards for New Buildings Act of 1976" Sec. 304(a)(2) mandates that National energy conservation performance standards be promulgated within three years after enactment of the Act. It was indicated that FmHA should defer action until such standard is promulgated.

FmHA has, since 1971, used the same Minimum Property Standards (MPS) as have HUD and VA. It has been the experience of FmHA in the past several years that homes built in accordance with the MPS are not sufficiently energy efficient for the low- and moderate-income persons who obtain housing loans from FmHA. Some houses have been conveyed into government inventory because the former owner could not pay the mortgage payment and the fuel bills for heating.

The basic authorities for the FmHA housing program (Section 502 of the Housing Act of 1949 as amended, 42 U.S.C. 1472) makes reference to the ability of an applicant and his family to maintain a reasonable standard of living as a qualification for loan eligibility. Based upon this, FmHA is compelled to examine not only the initial cost of purchasing a home but also the operating costs over the life of the mortgage.

FmHA has determined that existing thermal performance standards as stated in the Minimum Property Standards (MPS) do not provide adequate protection for the FmHA borrower or security for the interest of the government. The language of Pub. L. 94-385 states that standards promulgated thereunder will be minimum standards for Federal financial assistance and that other standards may be set which exceed those minimums. FmHA has consulted with HUD and VA and it has been determined that the FmHA Standards are in substantial conformity with revisions to the MPS which will be published at some future date.

3. FORMAT OF STANDARDS

A number of comments concerned the format of the proposed standard, stating that the proposed standards are prescriptive in nature rather than performance oriented. Several persons commented that performance standards are mandated by the Congress and that several model energy conservation codes namely ASHRAE 90-75 and the "Model Code for Energy Conservation in New Building Construction" being developed by the National Conference of States on Building Codes and Standards (NCSBCS) are performance oriented codes.

FmHA, in the development of the proposed standards, considered these model codes and carefully examined the level of performance which would result from the adoption of either code. In most cases, a dwelling unit constructed in accordance with ASHRAE 90-75 or the NCSBCS Model Code would not have a significantly different level of performance than a house built to the existing MPS.

The proposed standards were presented in a format similar to that used in the existing MPS which is easily understood by FmHA field personnel and contractors doing business under FmHA programs. FmHA, however, does consider valid those comments which suggested alternative means of compliance to attain the level of performance desired by FmHA. The final rules incorporate two optional methods of compliance which would permit alternative designs or technologies to be utilized which would provide energy usage equivalent to that attained by use of the component "U" factors. FmHA has adopted the basic format used in ASHRAE 90-75 for these options.

4. VALIDITY OF COST EFFECTIVENESS STUDY

Several comments questioned the validity of the basic methodology utilized to derive the proposed standard. One comment asserted that studies show that the "U" values used in the existing MPS are optimum values and that higher standards would not be cost effective. Other comments stated that computer studies performed by an industry group showed that reduction of "U" values from .17 to .10 would not be cost effective for certain construction types.

FmHA studies to derive optimum thermal performance levels were based upon construction costs, energy prices, energy usage patterns and typical construction types in all areas of the country. Marginal analysis was used to determine the point at which the last increment of savings equals the cost of providing the last increment of insulation thus resulting in the lowest total combined cost of mortgage and utility payments for the homeowner. This procedure is derived from the 1972 ASHRAE Handbook of Fundamentals, Chapter 17.

During the comment period, the base data has been resurveyed several times and the mathematical model has been examined in depth. Data compiled by FmHA has been correlated with results obtained by a computer modeling technique developed by the National Bureau of Standards. In several cases, changes in the final rules reflect additional thermal performance measures which are cost effective.

FmHA has also studied data concerning the computer study performed by the industry group and has consulted with other government agencies which may have been associated with that study. While FmHA acknowledges that computer modeling of dynamic patterns of energy usage is a valid analytical tool, it does not believe that the results of that study show sufficient cause for deviation from the standard as presented.

5. OTHER COST-EFFECTIVE MEASURES

Several comments addressed aspects of dwelling construction which were not addressed in the proposed standard. A number of comments indicated that a restriction on allowable glass area should be provided. FmHA anticipated, at the time the proposed rules were promulgated, that Revision No. 5 of the MPS, which contains a glass area restriction, would be published prior to promulgation of final rules. Revision No. 5 was published June 17, 1977, and all FmHA housing is now subject to a 15 percent maximum glass area limitation.

Several comments expressed concern that moisture problems could result from increased levels of insulation in walls and other structural cavities. FmHA concurs that this could constitute a significant problem in some instances and has amended the standards to include a section on vapor barriers.

Some comments indicated that infiltration of unconditioned air constitutes a major portion of energy usage and unless controlled, would effectively negate any benefits to be derived from increased thermal efficiency of the various components. FmHA concurs in this matter. Concurrent with the promulgation of proposed rules, FmHA has placed special emphasis upon adequate construction inspections by FmHA field personnel. Based upon data provided with some of the comments, the standards have been amended to include criteria for infiltration control.

A number of comments requested that efficiency and type of heating equipment be specified in the standard. FmHA does not consider specification of equipment type or type of fuel to be a valid inclusion in the standard. However, data available to FmHA indicates that providing combustion air from outside the conditioned space for fossil fuel burning equipment is a cost effective measure and has been included in the final rules. Also, taping of ductwork, has been determined cost effective and included.

EXHIBIT D

UNITED STATES DEPARTMENT OF AGRICULTURE
(FARMERS HOME ADMINISTRATION)

Construction Standards

I. *Purpose.* This exhibit prescribes construction standards to be used in all Rural Housing (RH) loan programs. These requirements shall supersede those listed in the Minimum Property Standards (MPS) No. 4900.1, "One and Two Family Dwellings," and 4910.1, "Multifamily Housing," as applicable.

II. *Policy.* All applications for new construction approved or conditional commitments issued after the effective date of this exhibit shall have drawings and specifications prepared to comply with paragraph III A or III C and III D of this exhibit. All existing dwelling to be bought with RH loan funds shall be considered in accordance with paragraph III B or III C of this exhibit.

III. *Minimum requirements.* A. All dwellings, single family or multifamily to be constructed with RH loan and grant funds shall comply with the following:

NEW CONSTRUCTION

MAXIMUM U VALUES FOR CEILING, WALL AND FLOOR SECTION OF VARIOUS CONSTRUCTION

Winter Degree Days (Note 1)	Ceilings	Walls	Floors (Note 2)	Glazing	Doors (Note 3)
1000 or less	.05	.08	.08	1.13	--
1001 to 2500	.04	.07	.07	.69	--
2501 to 4500	.03	.05	.05	.69	Storm door if hollow core door or if over 25% glass
4501 to 6000	.03	.05	.05	.47	Storm Door
6001 to 7000	.026	.05	.05	.47	Storm Door
7001 or more	.026	.05	.05	.47	Storm Door

Minimum R Values of Perimeter Insulation for Slabs-on-Grade

Winter Degree Days (65 F Base)	Minimum R Values (1) Heated Slab	Unheated Slab
500 or less	2.8	--
1000	3.5	--
2000	4.0	2.5
3000	4.8	2.8
4000	5.5	3.5
5000	6.3	4.2
6000	7.0	4.8
7000	7.8	5.5
8000	8.5	6.2
9000	9.2	6.8
10000 or greater	10.0	7.5

NOTE.—*(1) For increments between degree days shown, U values may be interpolated.

NOTE 1.—Winter degree days may be obtained from the ASHRAE Guide; the "NAHB Insulation Manual for Homes Apartments"; local utilities; and the National Climatic Center, Federal Building, Asheville, N.C.

Manuals are available from NAHB RF, Rockville, MD 20850, or NMWIA, 382 Springfield Avenue, Summit, N.J. 07901.

Other sources of degree day data may be used if available from a recognized authority.

NOTE 2.—For floors of heated spaces over unheated basements, unheated garages or unheated crawl spaces the U value of floor section shall not exceed the value shown.

A basement, crawl space or garage shall be considered unheated unless it is provided with a positive heat supply to maintain a minimum temperatuer of 50° F. Positive heat supply is defined by ASHRAE as "heat supplied to a space by design or by heat losses occurring from energy-consuming systems or components associated with that space."

Where the walls of an unheated basement or crawl space are insulated in lieu of floor insulation, the total heat loss calculated for floors with required insulation.

NOTE 3.—1¾ inch metal faced door systems with rigid insulation core and durable weatherstripping providing a "U" value equivalent to a wood door with storm door and an infiltration rate no greater than .50 cfm per foot of crack length tested according to ASTM E-382 at 2.86 psf of air pressure, may be substituted for a conventional door and storm door. All doors shall be weatherstripped.

B. All existing dwellings to be purchased with RH loan and grant funds shall be insulated in accordance with the following:

EXISTING CONSTRUCTION

MAXIMUM U VALUES FOR CEILING, WALL AND FLOOR SECTIONS OF VARIOUS CONSTRUCTION

Winter Degree Days (Note 1)	Ceilings	Walls (Note 2)	Floors (Note 3)	Glazing	Doors (Note 5)
1000 or less	.05		.08	1.13	--
1001 to 2500	.04		.07	.69	--
2501 to 4500	.03		.05	.69	Storm door if hollow core door or if over 25% glass
4501 to 6000	.03		.05	.69	Storm Door
6001 to 7000	.026		.05	.69	Storm Door
7001 or more	.026		.05	.69	Storm Door

NOTE 1.—Winter degree days may be obtained from the ASHRAE Guide; the "NAHB Insulation Manual for Homes Apartments"; local utilities; and the National Climatic Center, Federal Building, Asheville, N.C.

Manuals are available from NAHB RF, Rockville, Md. 20850, or NMWIA, 382 Springfield Avenue, Summit, N.J. 07901.

Other sources of degree day data may be used if available from a recognized authority.

NOTE 2.—Walls shall be insulated as near to new construction standards as economically feasible. Any exterior wall framing exposed during repair or rehabilitation work shall have vapor barrier installed and be fully insulated.

NOTE 3.—For floors of heated spaces over unheated basements, unheated garages or unheated crawl spaces the U value of floor section shall not exceed the value shown.

A basement, crawl space or garage shall be considered unheated unless it is provided with a positive heat supply to maintain a minimum temperature of 50 F. Positive heat supply is defined by ASHRAE as "heat supplied to a space by design or by heat losses occurring from energy-consuming systems or components associated with that space."

Where the walls of an unheated basement or crawl space are insulated in lieu of floor insulation, the total loss attributed to the floor from the heated area shall not exceed the heat loss calculated for floors with required insulation.

NOTE 4.—Slab edge insulation should be provided wherever practical in areas of 2,500 or more winter degree days. Rigid insulation placed on the exterior face of the slab shall be protected by a durable and weather resistant material.

NOTE 5.—Storm doors not required for double doors, sliding doors or others where installation would be economically infeasible. 1¾ inch metal faced door systems with rigid insulation core and durable weatherstripping providing a "U" value equivalent to a wood door with storm door and an infiltration rate no greater than .50 cfm per foot of crack length, tested according to ASTM E-382 at 2.86 psf of air pressure, may be substituted for a conventional door and storm door. All doors shall be weatherstripped.

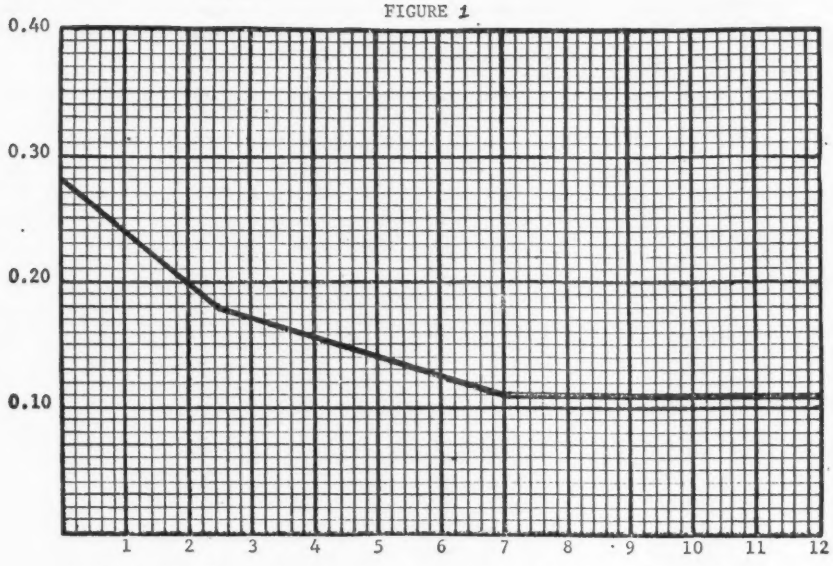
C. *Optional Standards.* Housing designs not in compliance with the requirements of paragraphs III A or III B of this exhibit may be approved in accordance with the provisions of this paragraph. Requests for acceptance proposed under paragraph C 1 which will be marketed solely within the jurisdictional area of one FmHA State Office may be approved by the State Director. Requests for acceptance proposed under paragraph C 1 which will be marketed within the jurisdictional areas of two or more FmHA State Offices and all requests for acceptance under paragraph C 2 may be approved by the Administrator.

All submissions of proposed options to the State Director or Administrator shall contain complete engineering data and calculations to document the validity of the proposal. All data and calculations will be based upon the current edition of the ASHRAE Handbook of Fundamentals or other universally accepted data sources.

1. *Overall "U" values for envelope components.* The following requirements shall be used in determining acceptable options to the requirements of paragraphs III A and III B.

a. U_o (gross wall)—Total exterior wall area (opaque wall and window and door) shall have a combined thermal transmittance value (U_o value) not to exceed the values shown in Figure 1. Equation 1 shall be used to determine acceptable combinations to meet the requirements of Figure 1.

FIGURE 1



ANNUAL FAHRENHEIT HEATING DEGREE DAYS (65 F BASE) (IN THOUSANDS)

Equation 1 formula for determining combinations (see Fig. 1).

$$U_o = \frac{U_{wall} A_{wall} + U_{window} A_{window} + U_{door} A_{door}}{A_o}$$

where:

U_{oq} = the average thermal transmittance of the gross wall area, Btu/h·ft²·F(W/m²K)

A_o = the gross area of exterior walls, ft²(m²) (see 4.2.2)

U_{wall} = the thermal transmittance of all lements of the opaque wall area, Btu/h·ft²·F(W/m²K)

A_{wall} = opaque wall area, ft²(m²)

U_{window} = the thermal transmittance of the window area, Btu/h·ft²·F(W/m²K)

A_{window} = window area (including sash) ft²(m²)

U_{door} = the thermal transmittance of the door area, Btu·h·ft²·F(W/m²K)

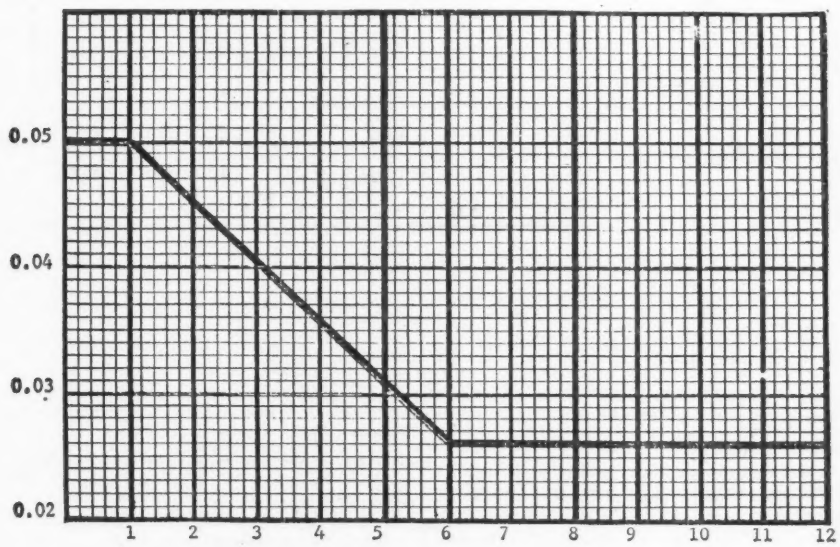
A_{door} = door area, ft²(m²)

NOTE.—Where more than one type of wall, window and/or door is used, the $U \times A$ term for that exposure shall be expanded into its sub-elements, as:

$U_{wall1} A_{wall1} + U_{wall2} A_{wall2}$, etc.

b. U_o (gross ceiling)—Total ceiling area (opaque ceiling and skylights) shall have a combined thermal transmittance value (U_o value) not to exceed the values shown in fig. 2. Equation 2 shall be used to determine acceptable combinations to meet the requirements of fig. 2.

FIGURE 2



ANNUAL FAHRENHEIT HEATING DEGREE DAYS (65 F BASE) (IN THOUSANDS)

Equation 2 formula for determining roof/ceiling combinations (see sec. 4.3.2.2.).

$$\frac{U_o = U_{roof} A_{roof} + U_{skylight} A_{skylight}}{A_o}$$

where:

U_o = the average thermal transmittance of the tross roof/ceiling area, Btu/h·ft²·F(Wm²K)

A_o = the gross area of a roof/ceiling assembly, ft² (m²) (see 4.2)

U_{roof} = the thermal transmittance of all elements of the opaque roof/ceiling are, Btu/h·ft²·F(Wm²K)

A_{roof} = opaque roof/ceiling area, ft²(m²)

$U_{skylight}$ = the thermal transmittance of all skylight elements in the roof/ceiling assembly, Btu/h·ft²·F(W/m²K)

$A_{skylight}$ = skylight area (including frame) ft²(m²)

NOTE.—Where more than one type of roof/ceiling and/or skylight is used, the $U \times A$ term for that exposure shall be expanded into its sub-elements, as:

$U_{roof1} A_{roof1} + U_{roof2} U_{roof2}$ etc.

c. U_o (gross floor)—Reserved.

2. *Overall structure performance.* The following requirements shall be used in determining acceptable options to the requirements of paragraphs III A and III B:

a. The methodology must be cost effective to the energy user.

b. The methodolgy must not adversely affect the structural capacity, durability or safety aspects of the structure.

c. All data and calculations must show valid performance comparisons between the proposed option and a structure comparable in size, configuration, orientation and occupant usage designed in accordance with paragraph III A or III B. Structures may be considered for FmHA loan consideration which can be shown by accepted engineering practice to have energy consumption equal to or less than those which would be attained in a representative structure utilizing the requirements of paragraphs III A or III B.

D. *Energy efficient construction practices.* This section prescribes those items of design and quality control which are necessary to guarantee the energy efficiency of homes built according to the standards of this exhibit. Also included are recommendations for extra energy efficiency in homes.

1. *Infiltration.* a. Requirements: All construction shall be performed in such a manner as to provide a building envelope free of excessive infiltration.

(1) Caulking and sealants. Exterior joints around windows and door frames, between wall cavities and window or door frames, between wall and foundation, between wall and roof, between wall panels, at penetrations of utility services through walls, floors and roofs, and all other openings in the exterior envelope shall be caulked, gasketed, weatherstripped, or otherwise sealed. Caulking shall be silicone rubber base or butyl rubber base, conforming to Federal Specifications TT–S–1543 and TT–S–1657 respectively, or materials demonstrating equivalent performance in resilience and durability.

(2) Windows shall comply with ANSI 134.1, NWMA 15–2; the air infiltration rate shall not exceed 0.5 ft³/min per ft. of sash crack.

(3) Sliding glass doors shall comply with ANSI 134.2, NWMA 15–3; the air infiltration rate shall not exceed .5 ft³/min per square ft. of door area.

(4) All insulation placed in open cavity walls shall be installed so that all spaces behind electrical switches and receptacles, plumbing, ductwork and other obstructions in the cavity are insulated as completely as possible. Insulation shall be omitted on the side facing the conditioned area.

Recommendations. Wrap outside corners of wall sheathing with 15 lb. asphalt impregnated building felt before siding application.

(2) Utilize vestibules for entry doors, especially those facing into the direction of winter wind.

(3) In design of the home, place plumbing, mechanical and electrical in interior partitions as much as possible.

2. *Heating and/or Cooling Equipment.*—a. Requirements: All mechanical equipment for heating and/or cooling habitable space shall be designed to provide economy of operation.

(1) All space heating equipment (including fireplaces) requiring combustion air shall be sealed combustion types, be located in a nonconditioned area or adequate combustion air must be provided from outside the conditioned space.

(2) All ductwork shall be designed and installed so as to minimize leakage. All metal to metal connections shall be mechanically joined and taped.

b. Recommendations: (1) Wherever possible, locate ductwork inside of conditioned areas in dropped ceilings, interior partitions or other similar areas.

(2) Locate outside cooling units in areas not subject to direct sunlight or heat build-up.

3. Vapor Barrier.—a. Requirements: Adequate vapor barriers must be provided adjacent to the interior finish material of the wall.

(1) A vapor barrier at the inside of the envelope component must have a perm rating no less than four times that of any other material in that component. All vapor barriers must be continuous and sealed around all openings in the interior surface.

(2) All vapor producing or exhausting equipment shall be ducted to the outside and be equipped with dampers.

B. Recommendation.—1. Forced air heating/cooling systems should include humidification/dehumidification systems where conditions indicate.

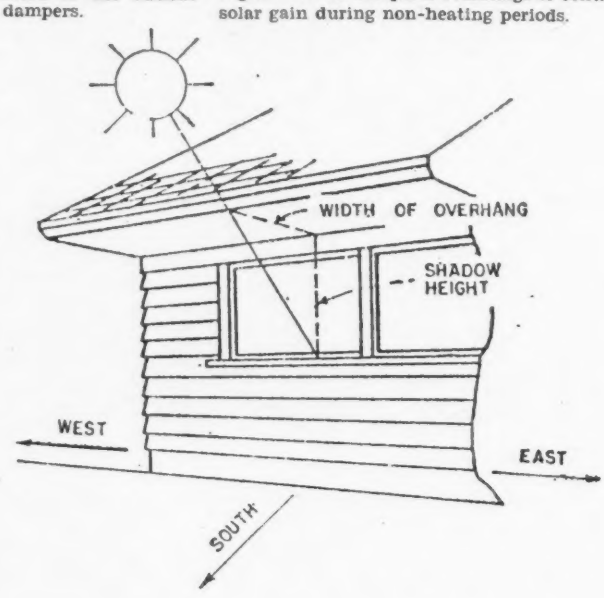
IV. *General Design Recommendations.* A. Orient homes with greatest glass areas facing south with adequate overhangs to control solar gain during non-heating periods.

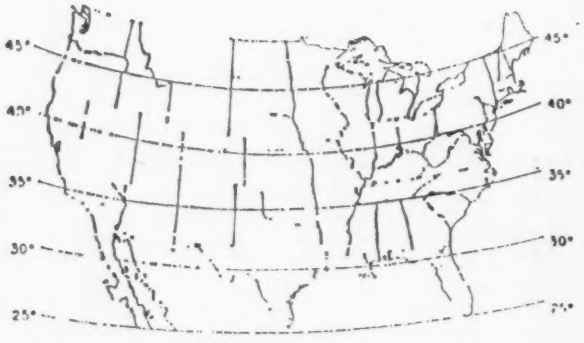
Roof overhangs, or extensions of the roof, over south walls are usually easy to incorporate into house designs. To determine the *width of overhang* needed to shade a south wall or window, follow this method:

(1) Consider the *latitude* of the geographical area in which your house is located. (See map below.) Latitude, together with season of the year, determines the angle at which the sun's rays strike the earth at different times of day.

(2) Measure on your plan or house the number of feet the south windows extend below the eave of the roof or horizontal overhang. This measurement is the *shadow height.*

(3) Then for that specific latitude and shadow height, you will find, from the table given here, the exact width of overhang needed:





NORTH LATITUDE (DEGREES)	SHADOW HEIGHT (FEET) 3	4	5	6	7	8
	WIDTH OF OVERHANG (FEET)					
25	1.1	1.5	1.9	2.2	2.6	3.0
30	1.4	1.9	2.4	2.9	3.4	3.8
35	1.8	2.4	3.0	3.5	4.1	4.7
40	2.1	2.8	3.6	4.3	5.0	5.7
45	2.6	3.4	4.3	5.1	6.0	6.8
50	3.0	4.1	5.1	6.1	7.1	8.2

For example, in a latitude of 35° and for a shadow height of 5 feet, the width of overhang needed is 3 feet.

B. Arrange plantings with evergreen wind buffers on north side and deciduous trees on south.

C. Wherever possible orient entry door away from winter winds.

D. Design house with simple shape to minimize exterior wall area.

E. Minimize glass areas within constraints of required light and ventilation, applicable safety codes and other appropriate considerations.

F. Minimize the amount of paved surface adjacent to the structure where heat gain is not desirable.

NOTE.—It is hereby certified that the proposed regulation was reviewed in accordance with Executive Order 11821 and OMB Circular A-107 issued November 7, 1976, by Executive Order 11949. An Economic Impact Statement has been prepared and is available for public inspection at the Office of the Chief, Directives Management Branch, Farmers Home Administration, U.S. Department of Agriculture, Room 6316, South Building, Washington, D.C. 20250.

(7 U.S.C. 1989 (42 U.S.C. 1480); delegation of authority by the Sec. of Agri., 7 CFR 2.23; delegation of authority by the Asst. Sec. for Rural Development, 7 CFR 2.70.)

Dated: October 18, 1977.

GORDON CAVANAUGH,
Administrator, Farmers Home Administration.

[FR Doc.77-30869 Filed 10-21-77;8:45 am]